TABLES

TABLE 4.2-1

Geologic Deposits
Present in the Vicinity of the BP Cherry Point Cogeneration Project

Geologic Stratigraphy	Hydrostratigraphic Units
Qbg – SAND AND GRAVEL OVERLYING BELLINGHAM DRIFT (Everson Interstade) – Pleistocene – Stratified sand and gravel. Mantles Bellingham Drift in western part of lowland. Probably formed by waves reworking Bellingham Drift and removing most of fine sediments. Lose, unfossiliferous, and moderately well sorted. Thickness as much as 10 feet.	Upper Water-Bearing Zone comprised of the Qbg sand and gravel where present and the weathered upper portion of the Qb Bellingham Drift.
Qb – BELLINGHAM DRIFT (Everson Interstade) – Pleistocene – Blue-gray, unsorted, unstratified pebbly, sandy silt and pebbly clay. Derived from rock debris melted out of floating ice and deposited on sea floor. Locally contains marine mollusks and wood, radiocarbon dated between 11,000 and 12,000 years before present. Glaciomarine drift mantles upland areas between flood plains below elevations of 600 feet. Named by Easterbrook (1963, p.1475-1478) for exposures 8 miles northeast of Bellingham. Type locality in sec. 34, T. 39 N., R. 4E., where unit caps section and is underlain by Deming Sand. Thickness up to 70 feet.	Qb – Bellingham Drift Aquatard. Lower unweathered potion of the deposit.
Qd* - DEMING SAND (Everson Interstade) – Pleistocene – Brown, stratified, well-sorted, medium to coarse sand with some layers of clay, silt, and gravel. Deposited as stream sediments when sea level stood 40 to 70 feet above present sea level. Shells in sand near Bellingham deposited in beach environment. Named by Easterbrook (1963, p.1475) for exposures along Nooksack River in sec. 34, T. 39 N., R. 4 E., 1 ¼ miles southeast of Cedarville, where unit overlies Kulshan Drift and underlies Bellingham Drift, Wood in basal peat at type locality dated at 11,6000 years B.P. Thickness about 30 feet.	Qd – Deming Sand Aquifer
Qk* - KULSHAN DRIFT (Everson Interstade) – Pleistocene – Blue-gray, unsorted and unstratified mixture of silt, clay, sand, and pebbles. Till like deposit not highly compacted, composed of debris melted out of floating glacier ice and deposited on the sea floor when seal level was at least 300 feet higher than present. Marine shells dated by radiocarbon between 11,600 and 12,900 years B.P. Named by Easterbrook (1963, p.1472-1475) for exposures along Nooksack River, 1-¼ miles southeast of Cedarville (sec. 34, T. 39 N., R. 4 E.) where unit is overlain by Deming Sand. Thickness generally 15 to 25 feet	Qk – Kulshan Drift Aquatard
Qvt* - VASHON TILL (Vashon Stade) – Pleistocene – Poorly sorted mixture of pebbles and cobbles in matrix of silt, clay, and sand derived almost entirely from British Columbia. Compact till with concrete like texture. Deposited by ice, up to 6,000 feet thick, from main advance of last major continental glaciation. Forms massive layer 10 to 30 feet thick beneath most of lowland. Contains a few lenses of sand and gravel. Limiting radiocarbon dates from other areas indicate an age between about 18,000 and 13,000 years.	Qvt – Vashon till aquatard. May contain local sand and gravel lens that produce water.
Qve* - ESPERANCE SAND MEMBER OF VASHON DRIFT (Vashon Stade) – Pleistocene – Crossbedded outwash sand and gravel deposited from melt-water streams from advancing Vashon glacier. Formed on outwash plain graded to a former sea level below the present. Beds as much as a 45 feet thick, pinch out laterally. No radiocarbon samples to date directly, but unit probably between 22,000 and 18,000 years old.	Qve – Esperance Sand Aquifer
Qu – Undifferentiated quaternary deposits of clays, silts, sands and gravel	Qu – Contains both aquifers and aquatards
TMs – Undifferentiated tertiary-mesosoic sandstones, siltstones, shales and coal beds	TMs – Bedrock typically a poor water producer. Fracture systems can yield sufficient supplies of water

Source: Modified from Easterbrook 1976, and Remediation Technologies Inc. 1993

TABLE 5.1-1

Water Rights, Permits, Certifications, and Claims in the Nooksack Basin (Upstream of Ferndale)

DOCUMENT NUMBER	DOCUMENT TYPE	PURPOSE CODE	PRIORITY DATE	Location	Qi (gpm)	Qa (acre-feet)	PURPOSE STARTING DATE	PURPOSE ENDING DATE	LAST NAME	FIRST NAME	BUSINESS NAME	SOURCE NAME
G1-*01249CWRIS	CERTIFICATE	IR	October 7, 1949	T39N / R02E-22	350	54					GREENACRES MEML PK	INFILTRATION TRENCH
G1-*02509CWRIS	CERTIFICATE	MU	May 9, 1952	T39N / R02E-19	1000	1615					FERNDALE TOWN OF	WELL
G1-*03899CWRIS	CERTIFICATE	MU	February 28, 1955	T39N / R02E-19	870	440					FERNDALE TOWN OF	WELL
G1-*05728CWRIS	CERTIFICATE	DS, FS, IR	September 7, 1960	T40N / R02E-07	810	193.6					LE COCQ R B	WELL
G1-*06660CWRIS	CERTIFICATE	IR	March 28, 1963	T40N / R02E-22	380	120					SHADY NOOK FARMS	WELL
G1-*10062CWRIS	CERTIFICATE	IR	March 7, 1969	T40N / R02E-10	500	84	01-May-96	01-Oct-96			SCHOESSLER G JR	INFILTRATION TRENCH
G1-00300CWRIS	CERTIFICATE	IR	July 10, 1970	T39N / R02E-02	400	108	01-Jun-96	30-Sep-96			VAUGHN LEONA	INFILTRATION TRENCH
G1-00010CWRIS	CERTIFICATE	IR	November 16, 1970	T40N / R02E-11	1209	67	01-May-96	30-Sep-96			STEENSMA FRED	WELL
G1-00444CWRIS	CERTIFICATE	IR	December 28, 1970	T40N / R01E-14	500	92	01-May-96	31-Oct-96			OLASON HAROLD	INFILTRATION TRENCH
G1-00345CWRIS	CERTIFICATE	IR, DS	February 15, 1972	T40N / R02E-15	450	66	5/15/1996 (IR)	9/15/1996 (IR)			YODER RICHARD L	WELL
G1-26325	CERTIFICATE	FR	September 11, 1991	T39N / R02E-06	1350				JANSEN	ALBERT	JJJ CONSTRUCTION CO., INC.	INFILTRATION TRENCH
S1-00708CWRIS	CERTIFICATE	CI, IR	September 27, 1968		12566	18544					Whatcom Cnty PUD 1	NOOKSACK RIVER
S1-00707C	CERTIFICATE	CI	April 16, 1965		22440	27667					WHATCOM CNTY PUD 1	NOOKSACK RIVER
S1-*11970C	CERTIFICATE	CI	January 13, 1953		2244	0					WHATCOM CNTY PUD 1	NOOKSACK RIVER
S1-00707C	CERTIFICATE	DM, IR	April 16, 1965		22440	27667					WHATCOM CNTY PUD 1	NOOKSACK RIVER
G1-*05086CWRIS	CERTIFICATE	MU	December 22, 1958		500	800					BLAINE CITY OF	WELL
G1-*07623CWRIS	CERTIFICATE	MU	May 21, 1965		400	640					BLAINE CITY OF	WELL
G1-22483CWRIS	CERTIFICATE	MU	April 14, 1975		450	726					BLAINE CITY OF	WELL
G1-300037CL	CLAIM /	MU			800	1290					CITY OF BLAINE	WELL
G1-26822	PERMIT	MU	November 13, 1992		200	320					CITY OF BLAINE	WELL

*Purpose Codes:

IR (irrigation)

ST (stock watering)

DG (domestic general)

CI (commercial & industrial manufacturing

DS (domestic single)

IR (irrigation)

DM (domestic multiple)

MU (domestic municipal)

FS (fish propogation)

FR (fire protection)

Source: Washington State Department of Ecology, WRATS Database, August 2001.

TABLE 5.1-2

Pending Groundwater Right Applications in the Terrell Creek / Cherry Point Watershed

DOCUMENT NUMBER	DOCUMENT TYPE	PURPOSE CODE	PRIORITY DATE	LOCATION	Qi (gpm)	BUSINESS NAME	SOURCE NAME
G1-27758	APPLICATION	CI, MU	August 23, 1996	T39N / R01E-09	700	PUD #1 OF WHATCOM COUNTY	WELL
G1-27746	APPLICATION	CI, MU	June 21, 1996	T39N / R01W-13	1500	TRILLIUM CORPORATION	WELL
S1-*06273AWRIS	APPLICATION	CI, DM	December 23, 1944		8976	WHATCOM CNTY PUD 1	SOUTH FORK NOOKSACK RIVER
G1-26820	APPLICATION	MU	November 13, 1992		200	CITY OF BLAINE	WELL
G1-26821	APPLICATION	MU	November 13, 1992		450	CITY OF BLAINE	WELL
G1-28046	APPLICATION	DM	August 3, 1999		500	BIRCH BAY WATER & SEWER DISTRICT	WELL

*Purpose Codes:
CI (commercial & industrial manufacturing
MU (domestic municipal)
DM (domestic multiple)
DG (domestic general
IR (irrigation)
ST (stock watering)
FP (frost protection)

Source: Washington State Department of Ecology, WRATS Database, August 2001.

TABLE 5.2-1

Source Water Quality

Constituent	Result	Units
Dissolved Oxygen	8.2	mg/l
Hydrogen Ion	7.2	pH units
Temperature	21.4	C
Chemical Oxygen Demand	ND	mg/l
Total Organic Carbon	0.55	mg/l
Total Nitrate/Nitrite	0.15	mg/l
Fluoride	ND	mg/l
Bromide	ND	mg/l
Vanadium	0.009	mg/l
Aluminum	0.523	mg/l
Antimony	ND	mg/l
Arsenic	ND	mg/l
Barium	0.010	mg/l
Beryllium	ND	mg/l
Cadmium	ND	mg/l
Chromium	ND	mg/l
Cobalt	ND	mg/l
Copper	ND	mg/l
Iron	0.368	mg/l
Lead	ND	mg/l
Manganese	0.009	mg/l
Mercury	ND	mg/l
Nickel	0.001	mg/l
Selenium	ND	mg/l
Thallium	ND	mg/l
Tin	ND	mg/l
Zinc	0.005	mg/l

Source: Duke Fluor Daniel 2001

TABLE 5.3-1

Chemicals Typically Used During Construction

Chemical	Purpose	Estimated Quantity	Storage Location
STG and pre-boiler piping cleaners	STG and pre-boiler piping cleaning waste, chelant chemical cleaner	400,000 gallons	Brought to site by equipment vendor/contractor
Solvents, used equipment lube oils, paints, adhesives	Used in construction	200 gallons monthly	Not known at this time
Used and waste oils	For CTG and STG lube oil flushes	200 55-gallon drums over life of construction	Not known at this time
Spent lead batteries	Various	3 batteries annually	Not known at this time
Spent alkaline batteries	Various	80 batteries monthly	Not known at this time
Waste oil from oily waste holding tank	Collected on site	25 gallons monthly	Not known at this time
Oil rags, oil absorbent	Generated during normal construction activities, excluding lube oil flushes	55 gallons monthly	Not known at this time
Argon Gas	Welding & HRSG components	Not known at this time	Temporary warehouse
Acetylene	Cutting torches	Not known at this time	Temporary warehouse
Helium	Welding aluminum ducts	Not known at this time	Temporary warehouse
Nitrogen	Welding	Not known at this time	Temporary warehouse
Oxygen	Cutting torches	Not known at this time	Temporary warehouse

Source: Duke/Fluor Daniel, 2001

Table 5.3-2
Summary of Anticipated Construction Waste Streams and Management Methods

Waste Stream	Waste Stream Classification	Estimated Amount	Estimated Frequency of Generation	No. Truck Trips & Frequency	Quantity Shipped
Scrap wood, steel, glass, plastic, paper, calcium silicate insulation, mineral wool insulation	Non-hazardous solids	50 cubic yards	Weekly	1 per week	50 cubic yards
Empty hazardous material containers	Hazardous solids	1.5 cubic yard	Weekly	1 per week	1.5 cubic yard
Used and waste lube oil during CT and ST lube oil flushes	Hazardous or non-hazardous liquids	55 gallon drums	200 drums over life of construction	1 per 60 days	25 - 55 gallon drums
Oil rags, oil absorbent generated during normal construction activities excluding lube oil flushes	Hazardous liquids	55 US gallons	Monthly	1 per month	55 US gallons
Solvents, used construction equipment lube oils, paint, adhesives	Hazardous liquids	200 US gallons	Monthly	1 per month	200 US gallons
Spent lead acid batteries	Hazardous solids	3 batteries	Yearly	1 per year	3 batteries
Spent alkaline batteries	Hazardous solids	80 batteries	Monthly	1 per month	80 batteries
ST and pre-boiler piping cleaning waste, chelant	Hazardous or non-hazardous liquids	400,000 US gallons	Once before initial startup	34	400,000 US gallons
Waste oil from oily waste holding tank	Hazardous or non-hazardous liquids	25 US gallons	Monthly	1 per month	25 US gallons
Sanitary waste from potable chemical toilets and construction office holding tanks	Non-hazardous liquids	500 US gallons	Daily	1 per week	500 US gallons
Storm water from construction area	Non-hazardous liquids	950,000 US gallons	For a once in 2 year, 24 hour storm event	n/a	n/a
Fluorescent, mercury vapor lamps	Hazardous solids	40	Yearly	1 per year	40
Hydrotest water	Hazardous or non-hazardous liquids	2 to 3 million gallons	Once before initial startup	34	2 to 3 million gallons

Source: Duke Fluor Daniel 2001

TABLE 5.3-3

Anticipated Commissioning and Hydrostatic Test Water Volumes

Commissioning and Hydrostatic Water Use	Total Gallons
Demineralizer system tests and tank fill, I	800,000
Demineralizer system tests and tank fill, II	800,000
HRSG 1 Hydrotest	150,000
HRSG 2 Hydrotest	150,000
HRSG 3 Hydrotest	150,000
Condensate and Boiler Feedwater Pipe Hydrotests and Flushes, I	200,000
Condensate and Boiler Feedwater Pipe Hydrotests and Flushes, II	200,000
Main Steam and Reheat Piping Hydrotest, I	100,000
Main Steam and Reheat Piping Hydrotest, II	100,000
Preboiler and HRSG 1 and 2 Chemical Cleaning, Including Flushes, I	600,000
Preboiler and HRSG 1 and 2 Chemical Cleaning, Including Flushes, II	600,000
Steam Blow HRSGs 1, 2 and 3	15,000,000
Condenser Hydrotest and Cleaning, I	200,000
Condenser Hydrotest and Cleaning, Ii	200,000

The total test water volume is 19,250,000 gallons.
Source: Duke Fluor Daniel, 2001

TABLE 5.3-4

Chemicals Used During Operations and Maintenance

Chemical	Estimated Quantity	Storage	Purpose
Lubrication oil	22,900 gallons	In STG and GTG equipment	STG / GTG equipment
Control oil	230 gallons	In STG equipment	STG equipment
Hydrogen	60,400 scf	GTG / STG gas bottles	Power generation
Carbon dioxide	41,000 scf	GTG / STG gas bottles	Power generation, estimate based on purge and fire protection requirements
Transformer oil	47,100 gallons	Combustion turbine transformers	12,000 gallons / combustion turbine
Transformer oil	17,200 gallons	Steam turbine transformers	15,000 gallons / steam turbine
Transformer oil	114,000 gallons	Auxiliary transformers	3,000 gallons / auxiliary transformer
Anhydrous Ammonia	940,000 annually	Above grade horizontal cylindrical tank	No_x reduction
SCR Catalyst	4,800 ft^3	In HRSG	No_x reduction
CO Catalyst	990 ft^3	In HRSG	CO reduction
Propylene glycol	17,500 gallons	Above grade tank	Closed loop cooling water system
BPC-68170 (nitrate / borate) corrosion inhibitor	50 gallons	Drum	Closed look cooling water system
BPB-59396 (diethyl hydroxylamine) oxygen scavenger	500 gallons	Tank	Water treatment system
BPB-59465 (morpholine) corrosion inhibitor	500 gallons	Tank	Water treatment system
Di- and trisodium phosphate pH / scale control agent	200 pounds	Bags / tank	Water treatment system
Cation resin	950 ft^3	Warehouse / tank	Water treatment system
Anion resin	900 ft^3	Warehouse / tank	Water treatment system
Caustic (50 wt%)	8000 gallons	Tank	Water treatment system
Sulfuric acid (93 wt%)	8000 gallons	Tank	Water treatment system
BPW-76321 (polyquaternary amine) polymer	350 gallons	Tank	Water treatment system
Natural Gas	N / A	Pipeline	Plant fuel system

Source: Duke / Fluor Daniel, 2001.

TABLE 5.3-5

Storage Tank and Sumps Description

Tank No.	Service/Purpose	Tank Type	Working Capacity US Gal	Diameter ft	Height ft	Design Standard	Secondary Containment
43-1213-1	Anhydrous Ammonia Storage Tank Store liquefied ammonia for use in SCR air pollution control system	Horizontal, cylindrical pressure vessel	11,650	9.0	25' long	ASME BPVC, Section VIII, Div I (365 psig)	Concrete Wall
43-1901-01	BFW & Condensate Storage Tank Storage for BFW and condensate returned from Refinery, prior to polishing treatment in demineralizer system	Vertical, cylindrical atmospheric above-ground tank (open-vented)	211,680	32.0	40.0	API 650	None
43-1901-01	Demineralized Water Storage Tank Provide supply of BFW makeup in the event that water delivery or treatment is temporarily interrupted	Vertical, cylindrical atmospheric above-ground tank (open-vented)	2,349,900	107.0	40.0	API 650	None
43-1903-01	Neutralization Tank Collect used demineralization regeneration chemicals, filter backwash, and other plant non-oily wastewaters to adjust pH as necessary to Refinery	Vertical, cylindrical atmospheric above-ground tank (open-vented)	115,000	34.0	40.0	API 650	None

TABLE 5.3-5

Storage Tank and Sumps Description

Tank No.	Service/Purpose	Tank Type	Working Capacity US Gal	Diameter ft	Height ft	Design Standard	Secondary Containment
43-1906-01	Closed Cooling Water System Head Tank Provide volume for coolant thermal expansion, fill and drain point	Vertical, cylindrical pressure vessel	450	3.5	6.0	API 650	None
43-1910-01	Oxygen Scavenger Tank Storage for BFW treating chemical	Vertical, cylindrical atmospheric	1,000	5'-2"	7'-4"	FRP	Curbed Area
43-1911-01	Neutralizing Amine Tank Storage for BFW treating chemical	Vertical, cylindrical, atmospheric	1,000	5'-2"	7'-4"	FRP	Curbed Area
43-1912-01	Phosphate Tank Storage for BFW treating chemical	Vertical, cylindrical, atmospheric	500	4'-0"	6'-3"	FRP	Curbed Area
43-1914-01	Acid Storage Tank Storage for Demineralizer anion bed regeneration	Horizontal, cylindrical, atmospheric	8,000	9'-0"	12'-6" S/S	ASME Section VIII Div I but not stamped	Concrete Wall
43-1915-01	Caustic Storage Tank Storage for Demineralizer cation bed regeneration	Horizontal, cylindrical, atmospheric	8,000	9'--0"	12'-6" S/S	ASME Section VIII Div I but not stamped	Concrete Wall
	Blowdown Sump Gravity drain collection point for	Below ground, concrete sump	17,240	12'Lx12'W	16' deep		
	HRSG boiler blowdown drain, pumped from sump to Neutralization Tank						

TABLE 5.3-5

Storage Tank and Sumps Description

Tank No.	Service/Purpose	Tank Type	Working Capacity US Gal	Diameter ft	Height ft	Design Standard	Secondary Containment
	Oily Water Sump (GTG & STG Area) Collection point for potentially oily runoff from washdown and precipitation, pumped to Refinery treatment system	Below ground, concrete sump	17,240	12'Lx12'W	16' deep		
	CTG Wash Water Sump Temporary storage of used wash water from periodic offline CTG cleaning, disposed offsite by vacuum truck	Below ground, concrete sump	17,240	12'Lx12'W	16' deep		

Source: Duke Fluor Daniel 2001

TABLE 5.4-1

Wastewater Flows and Chemical Composition

	Demin Plant Regeneration Water (includes Filter Backwash)	**Oily Wastewater**
Average Flow (gpm)	47	2
Peak Flow/Duration	250 gpm	120 gpm
	4 hrs / day	30 min / day
General Parameters		
pH (pH units)	6.5-8.5	7.0-7.5
Dissolved Oxygen (mg/L)	8	8
COD	ND	ND
BOD	ND	ND
Oil & Grease (mg/L)	0	10
TDS (mg/L)	6715	100
TSS (mg/L)	8	1
Temperature (°F)	Amb	Amb
Major Cation Conc. (mg/L)		
Ca	202	12
Mg	50	3
Na	1660	3
K	8.4	0.5
Major Anions Conc. (mg/L)		
HCO_3	722	43
CO_3	0	0
Cl	42	3
SO_4	3832	24
Trace Metals Conc. (mg/L)		
Ag	ND	ND
Al	8.79	0.523
As	ND	ND
Ba	0.17	0.01
Be	ND	ND
Cd	ND	ND
Cr	ND	ND
Co	ND	ND
Cu	ND	ND
Fe	6.15	0.366

TABLE 5.4-1

Wastewater Flows and Chemical Composition

	Demin Plant Regeneration Water (includes Filter Backwash)	**Oily Wastewater**
Hg	ND	ND
Mn	0.15	0.009
Ni	0.02	0.001
Pb	ND	ND
Sb	ND	ND
Se	ND	ND
Sn	ND	ND
Tl	ND	ND
V	0.15	0.009
Zn	0.08	0.005
Other Anions Conc. (mg/L)		
SiO_2	185	11
PO_4	0	0
F	ND	ND
NO_3/NO_2	2.52	0.15
NH_3/NH_4	0	0
Br	ND	ND
Organics Conc. (mg/L)		
Dissolved Organic Carbon	4	0
Polymers (polyquaternary amine)		
Others? (mg/L)		
Total Organic Carbon	9.24	0.55

Source: Duke Fluor Daniel 2001